EE292.2 **Final Examination** Date: April 07, 2004

Instructor: **G. Belev** Student Name: _____
Room: **2C72** Student #: _____
Time: **45 minutes**
*Note: Return this booklet to Room **2C72** upon completing*

Question 1:

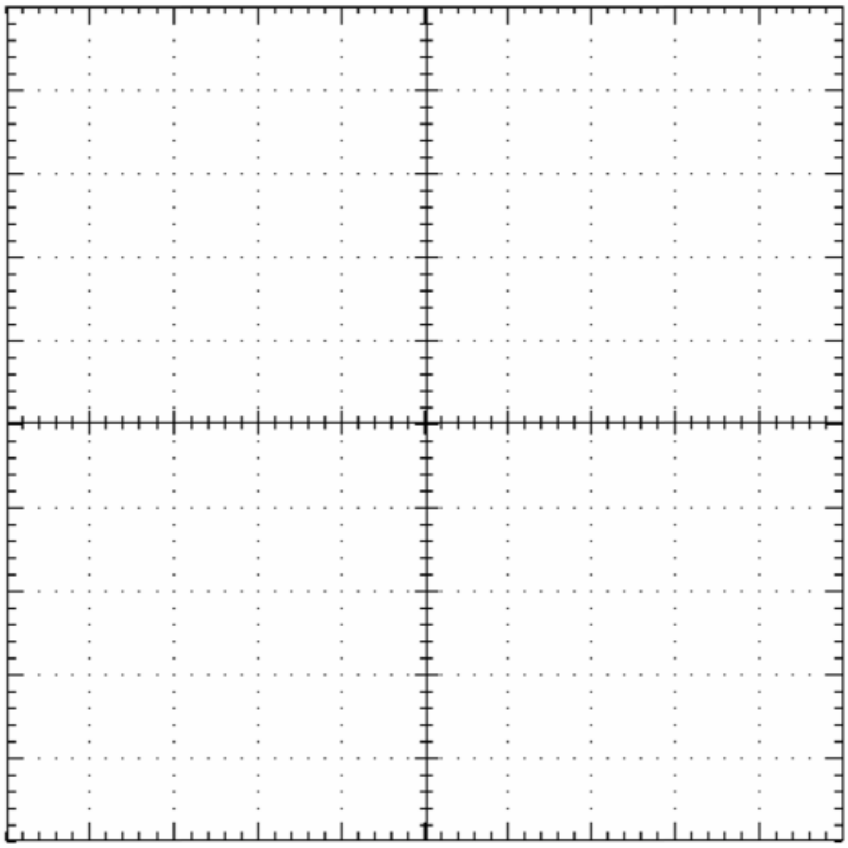
Every **T** periodic signal **x(t)** can be represented by its Fourier series

$$x(t) = a_0 + \sum_{n=1}^{\infty} a_n \cos(n\omega_0 t + \theta_n),$$

where $\omega_0 = \frac{2\pi}{T}$ is the fundamental frequency of the signal x(t) and a_0 is a DC component. Each term in the sum above is called harmonic. When n=1 we have the fundamental (first) harmonic, when n=2 we have the second harmonic and so on. The following is true for the amplitudes and the phases of all the harmonics: $a_n \geq 0$ *and* $0 \leq \theta_n < 2\pi$ *for* $n = 1...\infty$.

Connect to the input of the spectrum analyzer HP3580A a signal generator outputting a **triangular wave** with frequency **4 kHz,** amplitude **2 Vpp** and **zero DC offset**.

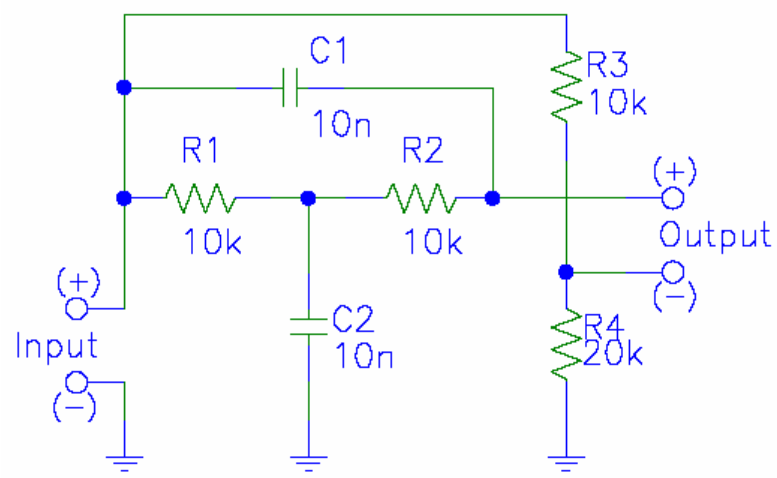
a) Display on the screen of the analyzer **the first 5 harmonics** with **largest** amplitudes. Sketch the screen on the place provided below. Fully label the axes.



b) Which harmonic has the second largest magnitude? What is the amplitude in dB and Volts of that harmonic?

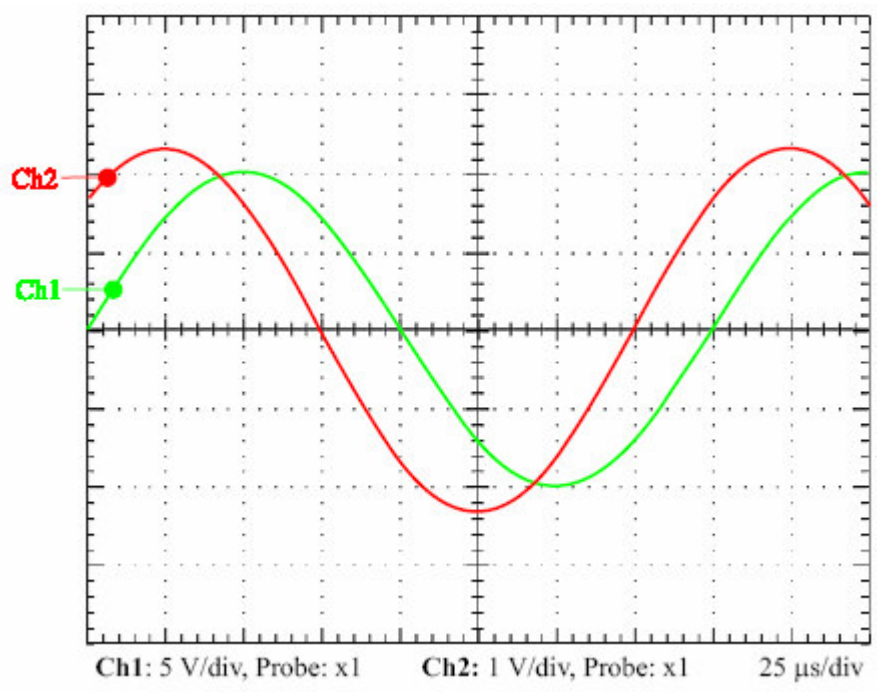
Question 2:

A schematic of a differential band reject filter is shown below.



a) Explain how you will connect the probes of an oscilloscope so as to display simultaneously on it screen the input and the output signal of the filter.

b) The input and the output of the filter are displayed on the screen below. **The input signal was connected to Ch 1 and the output signal to Ch 2.** Calculate the **phase shift** between the input and the output signal. Calculate the value of the **transfer function** of the filter at the shown frequency.



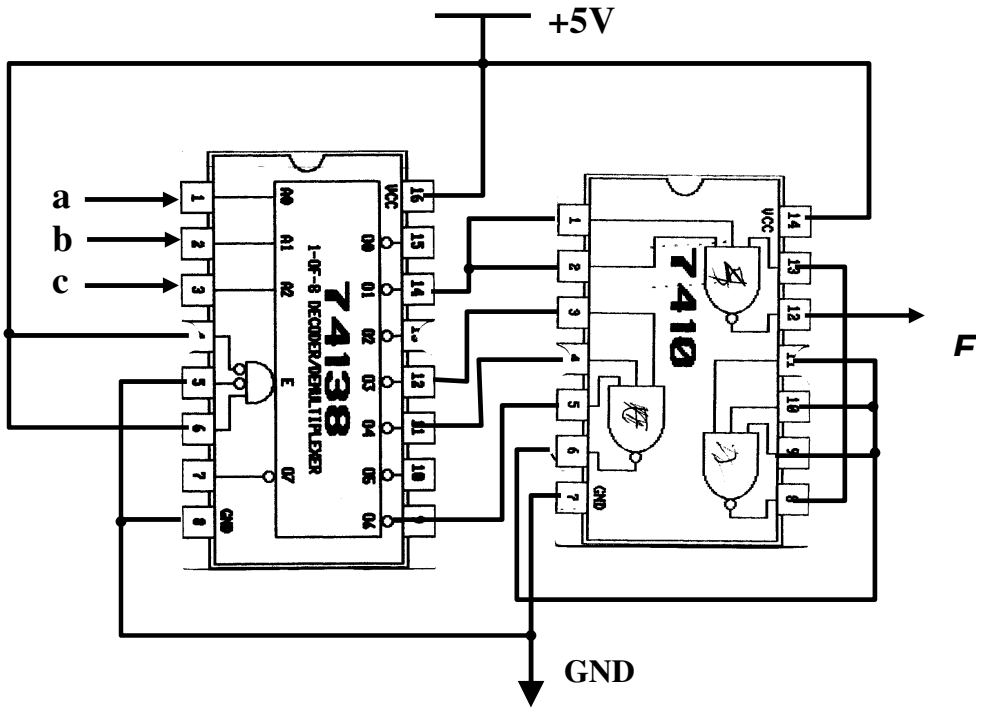
c) An attempt to experimentally obtain the transfer function of the filter produced the data shown in the table below. Estimate the **bandwidth (BW)** of the filter.

Frequency, Hz	H(f)	Frequency, Hz	H(f)	Frequency, Hz	H(f)
10	0.333	1200	0.062	5000	0.228
100	0.332	1400	0.028	6000	0.253
200	0.311	1500	0.013	7000	0.271
300	0.288	1592	0	10000	0.299
400	0.260	1700	0.014	50000	0.332
500	0.231	2000	0.051	100000	0.333
700	0.174	3000	0.137		
1000	0.101	4000	0.192		

EE292.2 **Final Examination** Date: April 07, 2004

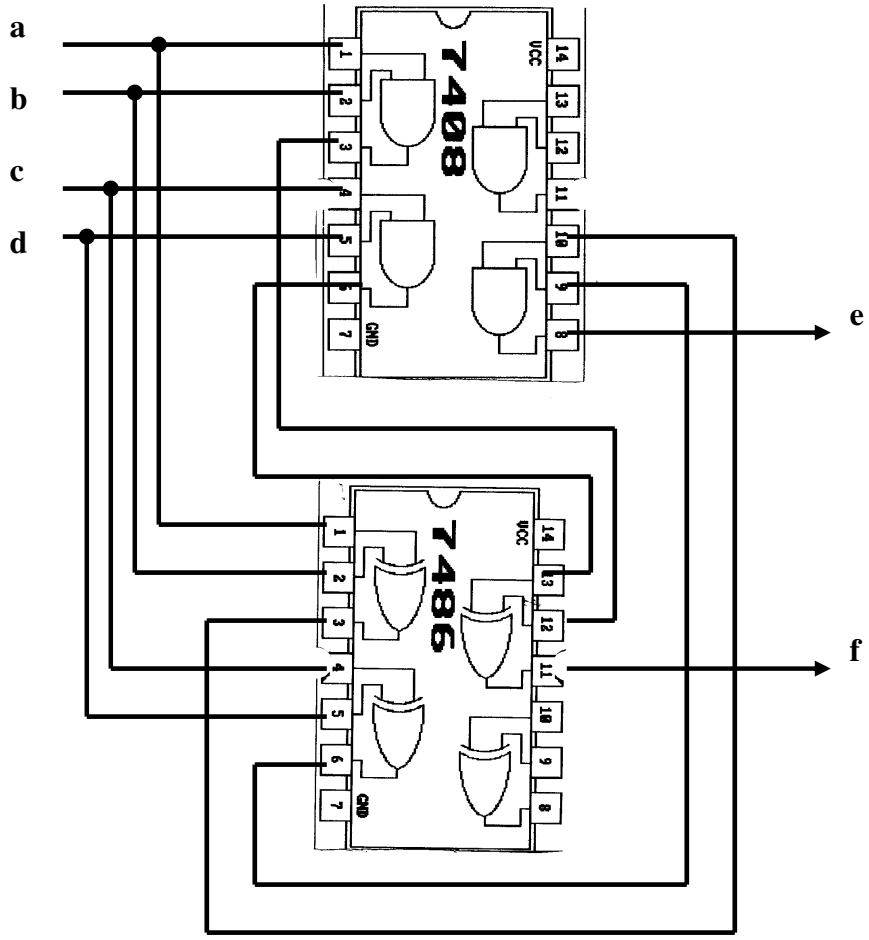
Instructor: **K. Ackerman** Student Name: _____
Room: **2C82** Student #: _____
Time: **45 minutes**
*Note: Return this booklet to Room **2C82** upon completing*

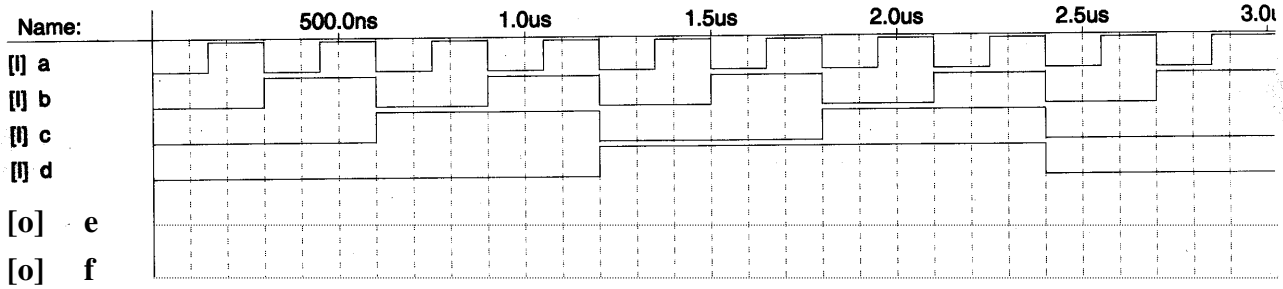
Question 1: Find Boolean expression of the function F(a,b,c) in the circuit below.



Question 2:

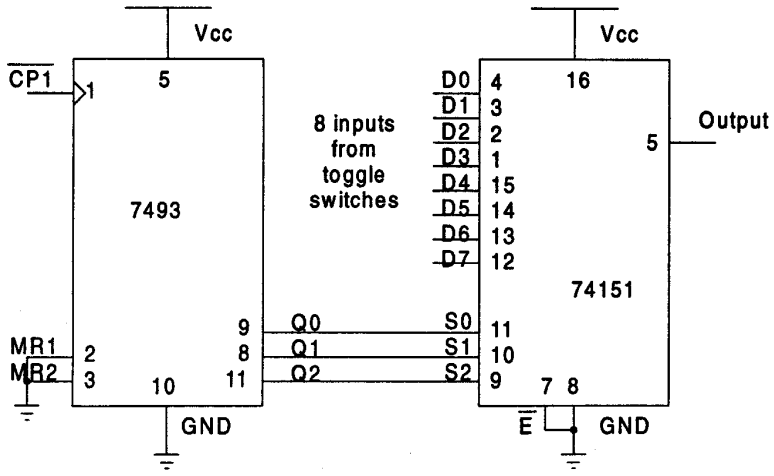
A technician sets up the circuit below to verify that the chips are functioning properly (Vcc and GND are not shown). Find the expressions of e and f as functions of a,b,c,d. Sketch the waveforms of e and f to help the technician verify the chips.





Question 3: *(Time allowed 15 minutes)*

For this question, the circuit has been set-up (mark the set-up number in your paper). Pin 1 of the 7493 3-bit counter is connected to a 1kHz, $2.5V_{0\text{-}P}$ square wave. Using the provided logic analyzer or oscilloscope, display the waveforms on pin 5, 9, 10 and 11 of the 74LS151. From the waveforms, determine its input word (D_0 to D_7).



Set-up #: _____

D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7

EE292.2 **Final Examination** Date: April 07, 2004

Instructor: **A. Mehr** Student Name: _____
Room: **2C70** Student #: _____
Time: **45 minutes**
*Note: Return this booklet to Room **2C70** upon completing*

Question 1: (4 marks) Connect the resistor and capacitor in series with a 120Vrms voltage source. Measure the power factor of this series circuit.

Station No.

Question 2: (6 marks) A balanced three- phase delta load is connected to a balanced three-phase voltage source.

(a) Discuss the two watt-meter method for the measurement of power going into the circuit. (Show the connections of watt-meters and use phasors to discuss the readings of the watt-meters.)

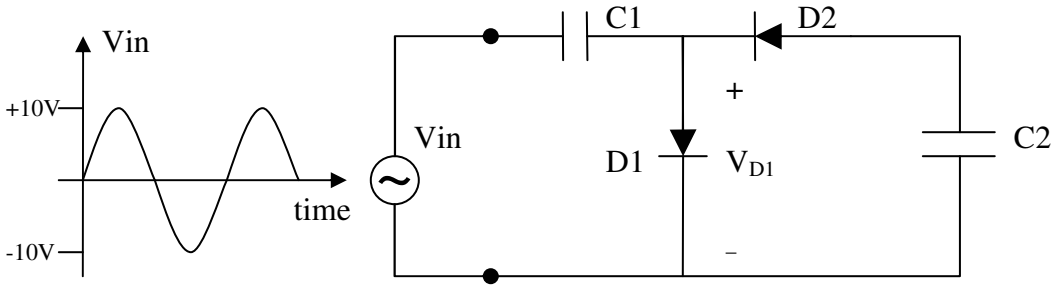
(b) Assume that the line voltage is Vab=208 V rms. The power is measured by the two watt-meter method: One of the watt-meters reads zero W, while the other one reads 400 W. Find the power factor and total power of the load.

EE292.2 **Final Examination** Date: April 07, 2004

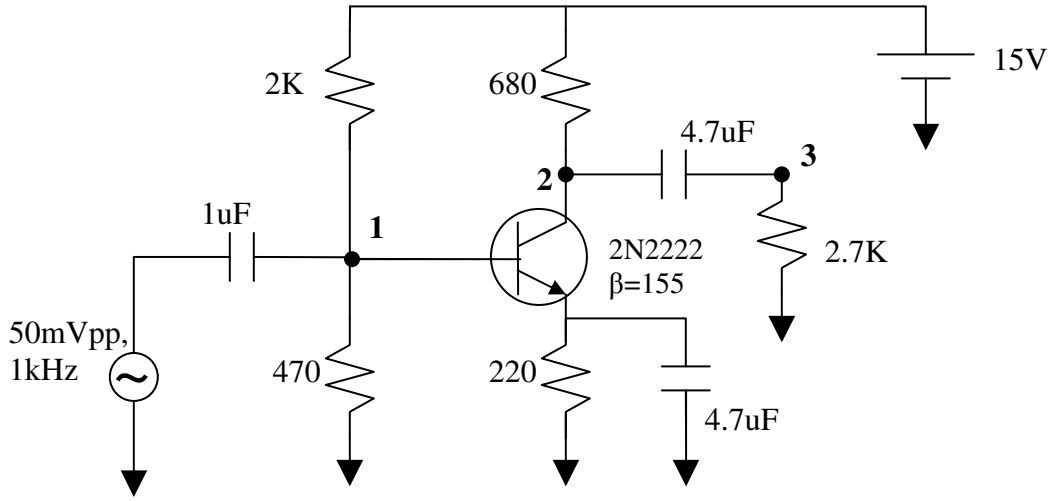
Instructor: **A. Dinh** Student Name: _____
Room: **2C80** Student #: _____
Time: **45 minutes**
*Note: Use the other side of the papers if needed. Return this booklet to Room **2C80** upon completing*

1) Answer the followings:

a) Assuming that the diodes are ideal and the capacitors have sufficient voltage and capacitance ratings. For the input waveform Vin as shown, sketch the voltage waveform V_{D1} across diode D1.



b) Make appropriate assumptions in your answer and sketch the waveforms (to scale) for nodes **1, 2** and **3** in the figure below.

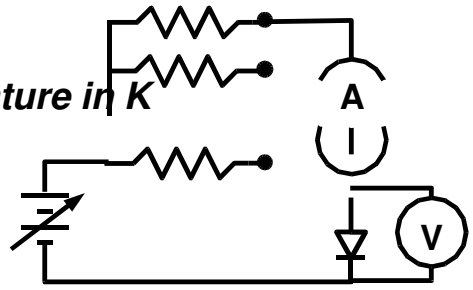


2) (*Maximum time allowed: 15 minutes*)

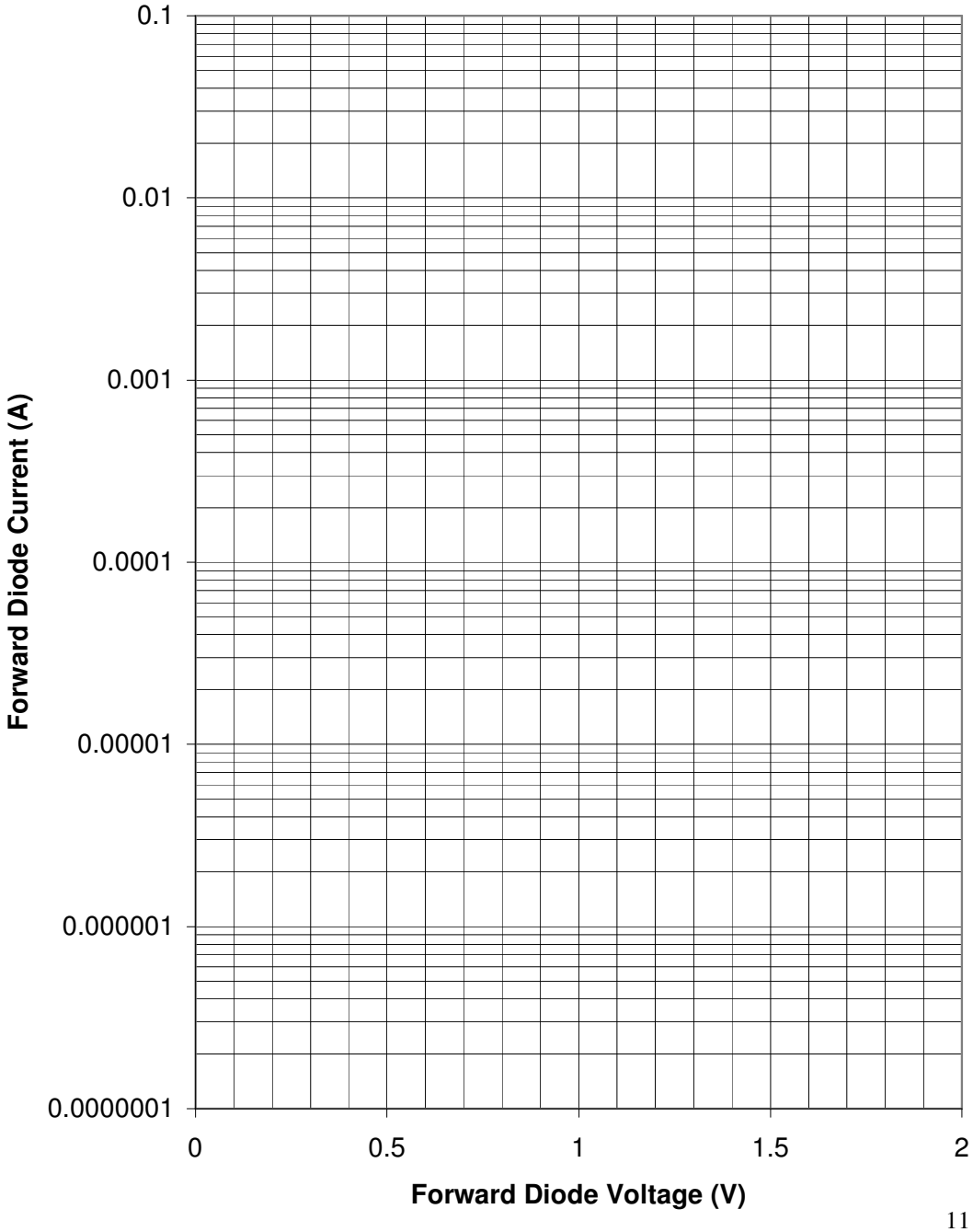
Determine "I_S" and 'n' for the unknown diode connected in the circuit (similar to that shown). Mark down the set-up number and briefly explain the procedure to obtain your results.

Recall that: $I_D \approx I_S e^{\frac{qV}{nkT}}$

q=1.602x10^{-19} C, k=1.38x10^{-23} J/K, T = temperature in K



Set-up number: _____
n = _____



3) (*Maximum time allowed: 15 minutes*)

Use the setup provided (approximately as shown below): 1) mark down the set-up number, 2) provide the print out of the scope display for "X" and "Y", 3) determine β_{AC} for the transistor Q1, and 4) briefly explain the procedure to obtain β_{AC}.

Set-up number:_____

β_{AC} **=** _____